Decentralized Wastewater Systems

Decentralized and Traditional Wastewater Treatment Systems

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Some Aspects of Decentralized Wastewater

- Decentralized compared to Centralized Systems
- What is “Decentralized?”
  - Collection, Treatment, and Dispersal at or near the location where the wastewater is generated
Decentralized compared to Centralized Systems

Collection
Treatment
Dispersal
Alternative Sewers: Alternative to What?

- Great Lakes
- Mississippi River Board Standards
- Traditional Gravity Sewers
Traditional Gravity Sewers

- Minimum pipe diameter is 8” nominal
- Minimum slope is 0.4% (0.04 ft per 100 feet)
- Design so slope would result in 2 feet per second velocity *if the pipe were flowing full*
- Manholes at every change of horizontal direction
- Manholes at every intersection of sewer mains
- Manholes at every change of slope
- Manholes at every change of pipe size
- Minimum manhole spacing is 400 feet for pipe diameters of 15 inches or less
- Allowable leakage for new construction is 800 gallons per day for 8” pipe under 2 feet of hydrostatic head.
Traditional Gravity Sewers, Cont’d.

- Lift pumps are designed to handle 3” diameter solids
- Force mains must be at least 4” in diameter
- Minimum pump flow must be approximately 80 gpm to maintain 2 ft per second velocity
Orenco Effluent Sewer Collection Technology
Orenco Effluent Sewer

Two Possibilities for On-Lot Equipment

- Septic Tank Effluent Pumping
- Septic Tank Effluent Gravity

Decentralized overview 3/3/2010 #8
Standard Configuration

Advantex® Textile Filters

Ventilation Assembly

Recirc Valve

Distribution Valve

Recirc/Blend Tank

Inlet

Outlet
Small Communities

Hebo, Oregon

- 60,000 gpd peak flow
- STEG collection
- 12 AX100 pods
- Uses UV disinfection and directly discharges to the nearby river
- Start-up: 1/2003
- Average effluent characteristics
  ~ BOD$_5$: 7 mg/L
  ~ TSS: 5 mg/L
Bethel Heights, Arkansas
System Implementation
Phase I

- Treatment Component
  ~ AdvanTex Treatment System
  ~ 30,000 gal/day design flow
  ~ 85+ EDU capacity
  ~ 6 AdvanTex AX100 pods
  ~ Capacity for 27 additional AX100s
Bethel Heights, Arkansas
System Implementation
Phase I

- Dispersal Component
  - Subsurface Drip Dispersal System
  - 9,000 gal dose tank
  - 50,788 SF drip field
  - Average hydraulic loading rate of 0.24 gal/day/ft²
Advantages to Residents

Frees Residents from Maintenance

• Collection systems are less expensive
  ~ They pay a sewer bill
  ~ Maintenance handled by utility

• Installation is less disruptive
Advantages to Developers

Cost

• Lowers land cost by allowing use of land outside urban growth boundaries
• Permits more lots per acre compared with individual septic
  ~ 60 to 80 lots in the space of 20 lots
• Reduces cost of decentralized collection and treatment to as little as $10,000/home
• Allows developers to defer capital outlay, saving interest
Advantages to Utilities

Creates Opportunities to Develop ...

• A new and profitable revenue stream
• A way to capture additional customers for other utility services
• A method for reducing load to existing wastewater system
Environmental Considerations

- 60 homes with treatment compared to 20 homes on septic systems
- 8 times less BOD load
- 1.4 times less nitrogen load
- 33 times less fecal coliform load
- PLUS the treatment system is managed and monitored for compliance.
Technology
Collection System

- Less expensive than gravity sewer
- No manholes, no lift stations
- Can go up and down hills
- On-lot components not constructed until home is built
- Largely immune to I&I and leakage
Technology
Collection System

- Effluent sewers
  - Interceptor tank
  - Pump package (for STEP)
  - Small diameter sewers

Typical gravity sewer.
Technology
Collection System

Gravity sewer construction.

Decentralized overview
Conventional Centralized Systems

- **Gravity Sewer** – minimum 8” diameter
- **GLUMRB Recommended Standards for Wastewater Facilities**
- **Typically Activated Sludge treatment**
- **Nutrient removal is by Biological Nutrient Removal (BNR)**
- **Typical Discharge to surface water under an NPDES permit**
Collection System

Conventional

- Collection System is minimum 8” diameter gravity sewer laid on a minimum 0.4 ft/100 ft grade with manholes located at all changes in alignment and at a minimum spacing of 400 feet

Decentralized

- Collection System can usually be 2” to 4” diameter sewer laid at constant depth similar to water line with cleanouts and isolation valves
Conventional

Decentralized

Decentralized overview 3/3/2010 #22
Pumping System

Conventional

- Submersible lift station with large solid handling pumps and control panels with SCADA systems and radio frequency transmitters to a central location.

Decentralized

- Individual home pumps as needed and generally with 115VAC motors. Easy to lift by one person. Remote monitoring can be done over the web through telephone modems.
Conventional

Decentralized

Decentralized overview 3/3/2010 #24
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Conventional</th>
<th>Decentralized</th>
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<tbody>
<tr>
<td><strong>Conventional</strong></td>
<td>• Activated Sludge with Biological Nutrient Removal.</td>
<td>• Media Filters, Extended aeration activated sludge, or SBR’s. Can be located at several sites and operated under a single RME. Can serve a single small watershed and have dispersed discharges (possibly to soil) or reuse for irrigation.</td>
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<td></td>
<td>Sensitive process easily upset.</td>
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<td>Large tanks and processes concentrated in one location.</td>
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<tr>
<td></td>
<td>Large, concentrated discharge to a stream</td>
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Traditional Treatment

- Activated sludge
  - Recommended Standards for Wastewater Facilities (2004 Ed.)
  - “...process requires close attention and competent operating supervision, including routine laboratory control....” aka .... Full time oversight/operation.
  - “...process requires major energy usage to meet aeration demands....” aka .... High power costs.
Discharge/Dispersal

Conventional

Decentralized
Some Considerations

- Infiltration and Inflow (I/I)
  Textbook value is 30,000 gpd/mile of sewer and house connections.

- Phosphorus removal - it can be as expensive to remove phosphorus as the rest of the treatment plant for the other components.

- Infiltration and Inflow – need watertight tanks and fittings. The pressure sewer is as tight as waterline.

- Soil has a strong affinity for phosphorus, and the phosphorus is used by plants.
Sewer Overflows
Infiltration/Inflow

Collapsed Tanks
Inadequate Tanks
The typical sewer bill is around $40 - $50 per home per month

Should include:

* Debt retirement
* O & M costs (about $15/home-month)
* Equipment replacement (sinking fund)
Some Words about tanks

- Watertight, watertight, Water tight, WATER TIGHT
- Tanks, connections, penetrations, riser connections
- Structurally sound
  - These systems are installed because the soil is not conducive to dense developments with traditional septic systems
  - In the south, that usually means high seasonal water tables that can be at or above tank penetrations, and maybe up to the tops of the risers.
Some more Tanks stuff

- Test the tanks IN THE HOLE, and on the yard
- This also allows a test of the connections
- Work out the material specifications to connect the riser to the tank
  ~ Has it been successfully done before in high seasonal water tables?
  ~ What type of adhesive or weld is used to make the connection to the tank?
  ~ How do you join PVC to polyethylene? How do you join PVC to fiberglass?
Tank Stuff

- Work out the connection from the tank discharge line to the sewer main – flexible, water tight, and durable.
  Just because it’s concrete and stout doesn’t mean it is water tight
- Just because it’s fiberglass and watertight doesn’t mean that it’s structurally sound
- Just because it’s polyethylene and flexible doesn’t mean that it’s either - % “regrind”
A concrete tank that came from a manufacturer
Whose tanks are certified by the Department of Health as watertight
Fiberglass Tank
Polyethylene tank
Management of Decentralized Systems

- Rural Water Districts/Authorities
- Sewer Improvement Districts
- Private PSC-regulated utilities
- Other
Maintaining Gravity Sewers

- Big Equipment = Big Cost
- Traffic Control
Maintaining Effluent Sewer

- Small equipment = small costs
Glide, Oregon STEP system

- Average of 218 hours per year for service calls
- 800 Equivalent Dwelling Units
- Average of 0.27 hours per year per equivalent dwelling unit
Some factors to consider when implementing a successful decentralized project

• Develop good standards and specifications
  ~ This may mean research into equipment performance
  ~ Research into costs – both capital costs, and long-term maintenance costs (life-cycle costs)
• Hold the line on the specifications
• Try to standardize on one equipment package
  ~ Fewer parts and pieces to inventory
  ~ Repairs and maintenance are easier
Solutions for Decentralized Wastewater Treatment

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